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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

(Docket No: 205.002)

International Application No.: **PCT/EP00/06493**

International Filing Date: **JULY 8, 2000**

Priority Date Claimed: **OCTOBER 6, 1999**

Title: **METHOD FOR OPERATING A WIND FARM**

Applicant: **WOB BEN**

Commissioner of Patents and Trademarks
Washington, DC 20231

**TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371**

Dear Sir:

To effect the filing of the above-referenced application in the United States Patent and Trademark Office as the United States Designated/Elected Office (DO/EO/US), Applicant submits herewith, pursuant to 35 USC 371 et seq. and 37 CFR 1.491 et seq., the following items and other information:

1. ☒ This is a FIRST submission of items concerning a filing under 35 USC 371.
2. ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 USC 371.
3. ☒ This is an express request to begin national examination procedures (35 USC 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 USC 371(b) and PCT Articles 22 and 39(1).
4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2)):
 - a. ☒ is transmitted herewith.
 - b. ☒ has been transmitted by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).

6. **[XX]** An English translation of the International Application (35 USC 371(c)(3)).
7. **[XX]** A copy of the International Search Report (PCT/ISA/210), including the references cited therein.
8. **[XX]** Amendments to the claims of the International Application under PCT Article 19 (35 USC 371(c)(3)):
 - a. **[XX]** are transmitted herewith.
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☐ have not been made and will not be made.
9. **[XX]** An English translation of the amendments to the claims under PCT Article 19 (35 USC 371(c)(3)).
10. **[XX]** An unexecuted oath or declaration of the inventor (35 USC 371(c)(4)).
11. **[XX]** A copy of the International Preliminary Search Report (PCT/IPEA/409).
12. **[XX]** A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 USC 371(c)(5)), if any.
13. **[XX]** An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet is included.
15. ☐ A preliminary amendment.
16. ☐ A substitute specification.
17. **[XX]** A power of attorney and/or address letter, see item 18, immediately below.
18. **[XX]** The communication address with respect to this application is:

Neil Steinberg
Steinberg & Whitt, LLP
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Mountain View, CA 94043

Telephone: 650-968-8079
Facsimile: 650-968-8102

FEE CALCULATION

The following fees are submitted:

Basic National Fee (37 CFR 1.492(a)(1)-(5)):

- ☒ International Search Report has been prepared by the EPO or JPO \$890.00
- ☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) \$710.00
- ☐ No international preliminary examination fee paid to USPTO (37 CFR 1.482)
but international search fee paid to USPTO (37 CFR 1.445(a)(2)) \$740.00
- ☐ Neither international preliminary examination fee (37 CFR 1.482)
nor international search fee paid to USPTO (37 CFR 1.445(a)(2)) \$1,040.00
- ☐ International preliminary examination fee paid to USPTO (37 CFR 1.482)
and all claims satisfied provisions of PCT Article 33(1)-(4)..... \$100.00
- BASIC NATIONAL FEE AMOUNT \$ 890.00**

Surcharges and Reductions:

- ☐ Surcharge of \$130.00 for furnishing the oath or declaration later
than 20 months or 30 months from the earliest claimed priority
date (37 CFR 1.492(e)) \$ -0-
- ☐ Surcharge for more than 20 total claims (0 x \$18.00) \$ -0-
- ☐ Surcharge for more than 3 independent claims (0 x \$84.00) \$ -0-
- ☐ Surcharge for multiple dependent claims \$ -0-
- ☐ Reduction of 1/2 for filing by small entity, if applicable \$ -0-
- ☐ Processing fee of \$130.00 for furnishing the English Translation later than
20 or 30 months from the earliest claimed priority date (37 CFR 1.492(f))..... \$ -0-

TOTAL NATIONAL FILING FEE \$ 890.00

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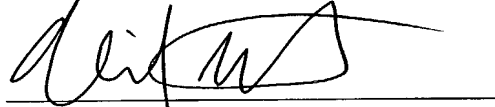
FORM OF PAYMENT

Payment of the Total Filing Fee is as follows:

- ☒ [XX] A check payable to the Commissioner of Patents and Trademarks, in the amount of \$890.00 is enclosed as payment of the Total Filing Fee.
- ☐ [] Please charge my Deposit Acc. No. 50-0763 in the amount of \$_____ to cover the above fees. A duplicate copy of this sheet is enclosed.
- ☒ [XX] The Commissioner is hereby authorized to charge any fees that may be required, or credit any overpayment to Deposit Acc. No. 50-0763. A duplicate copy of this sheet is enclosed.

Date: April 2, 2002

Respectfully submitted,



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(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES
PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

(19) Weltorganisation für geistiges Eigentum
Internationales Büro



(43) Internationales Veröffentlichungsdatum
12. April 2001 (12.04.2001)

PCT

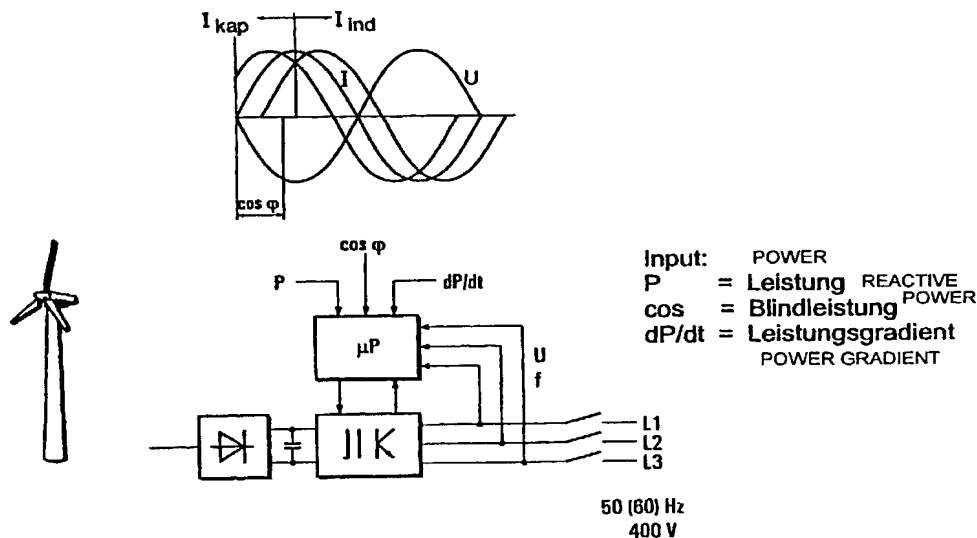
(10) Internationale Veröffentlichungsnummer
WO 01/25630 A1

- (51) Internationale Patentklassifikation⁷: F03D 7/00, H02J 3/46 (74) Anwalt: GÖKEN, Klaus, G.; Eisenführ, Speiser & Partner, Martinstrasse 24, D-28195 Bremen (DE).
- (21) Internationales Aktenzeichen: PCT/EP00/06493 (81) Bestimmungsstaaten (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (22) Internationales Anmeldedatum: 8. Juli 2000 (08.07.2000)
- (25) Einreichungssprache: Deutsch
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- (30) Angaben zur Priorität: 199 48 196.2 6. Oktober 1999 (06.10.1999) DE
- (71) Anmelder und
(72) Erfinder: WOBLEN, Aloys [DE/DE]; Argestrass 19, D-26607 Aurich (DE).
- (84) Bestimmungsstaaten (*regional*): ARIPO-Patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), eurasisches Patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), europäisches Patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI-Patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

[Fortsetzung auf der nächsten Seite]

(54) Title: METHOD FOR OPERATING A WIND FARM

(54) Bezeichnung: VERFAHREN ZUM BETRIEB EINES WINDPARKS



(57) Abstract: The invention relates to a method for operating a wind farm and to a wind farm. Said wind farm consists of at least two wind turbines, the power provided by these wind energy turbines being limited in amount to a maximum possible input to the network which is less than the maximum possible value of power to be provided (nominal power). The maximum possible value to be input is determined by the receiving capacity (power capacity) of the network into which the energy is input and/or by the power capacity of the energy transmission unit or the transformer by which means the energy generated by the wind turbine is input into the network.

[Fortsetzung auf der nächsten Seite]

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Aloys Wobben, Argestrasse 19, 26607 Aurich

Method of operating a wind park

The invention concerns a method of operating a wind park and also a wind park as such.

Wind power installations were initially always set up as singular units and it is only in recent years that wind power installations have frequently been installed in wind parks, this being due also to administrative and building regulations. In that respect a wind park, in its smallest entity, is an arrangement of at least two wind power installations but frequently markedly more. By way of example mention may be made of the wind park at Holtriem (East Frisia in Germany), where more than 50 wind power installations are set up in an array. It is to be expected that the number and also the installed power output of the wind power installations will also rise greatly in future years. In most cases the wind potential is at its greatest in regions of the power supply networks with a low short-circuit capacity and a low level of population density. It is precisely there that the technical connection limits are rapidly attained by

the wind power installations, with the consequence that no further wind power installations can then be set up at such locations.

A conventional wind park which is connected for example to a 50 MW substation can therefore have at a maximum only 50 MW total power output, that is to say for example 50 wind power installations each involving a rated power output of 1 MW.

Bearing in mind the fact that the wind power installations are not constantly operated at the rated level and thus the entire wind park also does not continuously reach its maximum power output (rated power output), it can be established that the wind park is not put to optimum use if the rated power output of the wind park corresponds to the maximum possible total power output which is to be fed in.

The invention accordingly proposes a solution in which the wind park is equipped with a total power output which is higher than the maximum possible network feed-in power output. When applied to the above-indicated example, the power output can be raised to a value of over 50 MW, for example 53 MW. As soon as the wind speeds are sufficiently high to produce a limit power output of 50 MW, the wind park regulation in accordance with the invention comes into operation and regulates down individual ones of or all installations when the total maximum power output is exceeded, in such a way that same is always observed. This means that, at wind speed above nominal or rated wind (wind speed at which a wind power installation reaches its rated power output), at least one or all installations is or are operated with a (slightly) throttled power output (for example with a power output of 940 kW instead of 1 MW).

The advantages of the invention are apparent. Considered overall the network components of the feed network (network components are for example the transformer and the lines) are utilized or loaded in the optimum fashion (utilization up to the thermal limit is also a possibility). This means that existing wind park areas can be better utilized, by virtue

of setting up a maximum possible number of wind power installations. That number is then no longer (so severely) limited by the existing network capacity.

For the purposes of control/regulation of a wind power installation, it is desirable if it has a data input, by means of/by way of which the electric power output can be adjusted in a range of between 0 and 100% (with respect to the rated power output). If for example a reference value of 350 kW is applied to that data input, the maximum power output of that wind power installation will not exceed the reference value of 350 kW. Any value between 0 and the rated power output (for example from 0 to 1 MW) is possible as the reference value.

That data input can be used directly for power output limitation purposes.

It is however also possible by means of a regulator to regulate the generator output in dependence on the network voltage (in the wind park network or in the feed network).

A further important function is discussed hereinafter with reference to wind park regulation. It will be assumed by way of example that a wind park comprises 10 wind power installations which each have a rated power output of 600 kW. By virtue of the capacitances of the network components (line capacitances) or the limited capacitances in the substation it will further be assumed that the maximum power output to be delivered (limit power output) is limited to 5200 kW.

There is now the possible option of limiting all wind power installations to a maximum power output of 520 kW by means of the reference value (data input). That satisfies the requirement for limiting the power output to be delivered.

Another possible option involves not exceeding the maximum power output, as the sum of all installation, but at the same time generating a maximum amount of power (kW-hours (work)).

In that respect, it should be known that, at low to moderate wind speeds, within the wind park, it frequently comes about that the wind power installations at the favorable (good) locations (these are the locations at which the wind impinges first within the wind park) receive a great deal of wind. If now all wind power installations are simultaneously regulated down to their throttled value (for example all to 520 kW), that generated power output is admittedly attained by some wind power installations which are disposed at good locations, but some other wind power installations which stand in the "wind shadow" of the well-located wind power installations (being in the second and third rows) receive less wind and as a result operate for example only with a power output of 460 kW and do not reach the value of the maximum throttled power output at 520 kW. The total power output generated in the wind park is accordingly substantially below the permitted limit power output of 5200 kW.

15 In this case the wind park power output regulation procedure according to the invention regulates the individual installations in such a way that the maximum possible energy yield occurs. This means in specific terms that for example the installations in the first row (that is to say at good locations) are regulated to a higher power output, for example
20 to the rated power output (that is to say no throttling action). This means that the overall electrical power output in the wind park rises. The park regulation arrangement however regulates each individual installation in such a way that the maximum permitted electrical connection power output is not exceeded while at the same time the work produced (kWh)
25 reaches a maximum value.

The wind park management according to the invention can be easily adapted to the respective situations which arise. Thus it is very easily possible for example to implement different throttling of the power output of individual installations if an individual installation or a plurality of installations of a wind park are (have to be) taken off the network, if

either for maintenance reasons or for other reasons and an individual installation or a plurality of installations have to be temporarily shut down.

For control/regulation of the wind park or the individual installations, it is possible to use a data/control processing apparatus
 5 which is connected to the data inputs of the installations and which, from the wind speeds which are ascertained (in respect of each installation), ascertains the respectively most advantageous power output throttling value for an individual installation or the entire wind park respectively.

Figure 1 is a block circuit diagram showing control of a wind power
 10 installation by means of microprocessor μP which is connected to an inverter arrangement (PWR), by means of which polyphase alternating current can be fed into a power supply network. The microprocessor has a power entry input P, an input for inputting a power factor ($\cos \varphi$) and an input for inputting the power gradient (dP/dt).

15 The inverter arrangement comprising a rectifier, a rectifier intermediate circuit and an inverter is connected to the generator of a wind power installation and receives therefrom the energy produced by the generator, in rotary speed-variable fashion, that is to say in dependence on the speed of rotation of the rotor of the wind power
 20 installation.

The design configuration shown in the Figure serves to explain how the power output from a wind power installation can be limited in respect of its magnitude to a maximum possible network feed value.

Figure 2 is a view illustrating the principle of a wind park comprising
 25 for example three wind power installations 1, 2 and 3 of which – as viewed from the direction of the wind – two are disposed in side-by-side relationship and the third is positioned behind the first two. As each of the individual wind power installations has a power input for setting the power output of the respective installation (Figure 1), the power output levels of
 30 an individual wind power installation can be set to a desired value by means of a data processing apparatus, by means of which the entire wind

park is controlled. In Figure 2 the advantageous locations of the wind power installations are those on which the wind impinges first, that is to say the installations 1 and 2.

[illegible]

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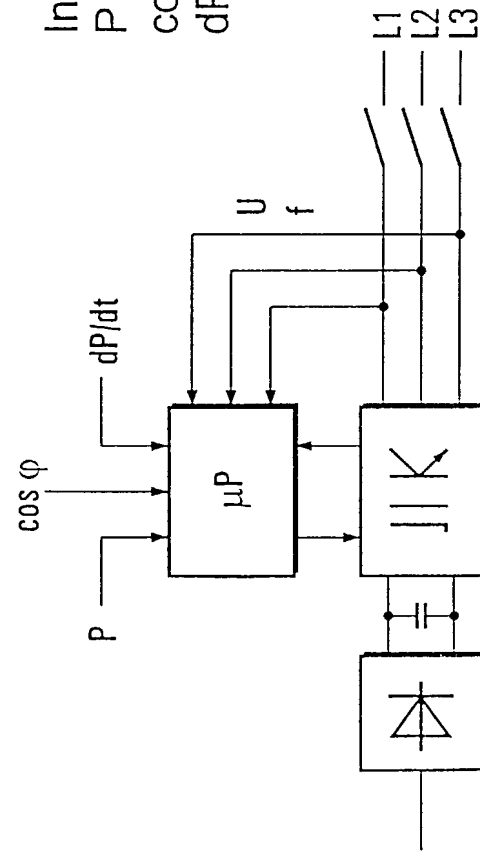
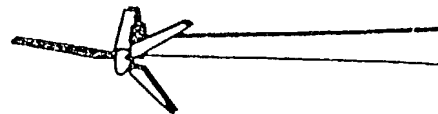
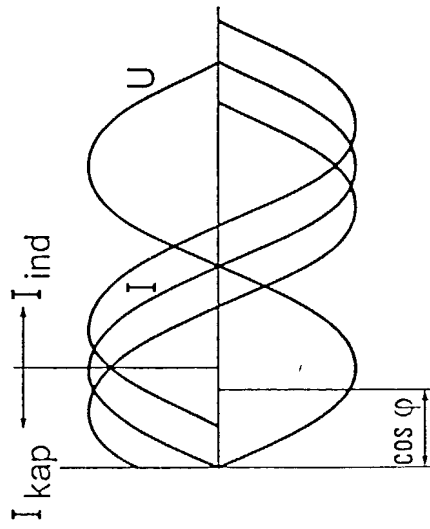
depending on how great the respective power output is, which the entire wind park makes available at its output for feeding into an energy network.

6. A wind park as set forth in one of the preceding claims characterized in that the wind power installations which are first exposed to the wind within the wind park are less limited in their power output than wind power installations which are behind the aforementioned wind power installations in the direction of the wind.

$$x_0 = \frac{7}{8}, x_1 = \frac{6}{8}, x_2 = \frac{5}{8}, x_3 = \frac{4}{8}, x_4 = \frac{3}{8}, x_5 = \frac{2}{8}, x_6 = \frac{1}{8}, x_7 = \frac{0}{8}$$

Wind power installations were initially always set up as singular units and it is only in recent years that wind power installations have frequently been installed in wind parks, this being due also to administrative and building regulations. In that respect a wind park, in its smallest entity, is an arrangement of at least two wind power installations but frequently markedly more. By way of example mention may be made of the wind park at Holtriem (East Frisia in Germany), where more than 50 wind power installations are set up in an array. It is to be expected that the number and also the installed power output of the wind power installations will also rise greatly in future years. In most cases the wind potential is at its greatest in regions of the power supply networks with a low short-circuit capacity and a low level of population density. It is precisely there that the technical connection limits are rapidly attained by the wind power installations, with the consequence that no further wind power installations can then be set up at such locations.

(Figure 1)



50 (60) Hz
400 V

Fig. 1

Input: P = Power output
 \cos = Reactive power output
 dP/dt = power output gradient

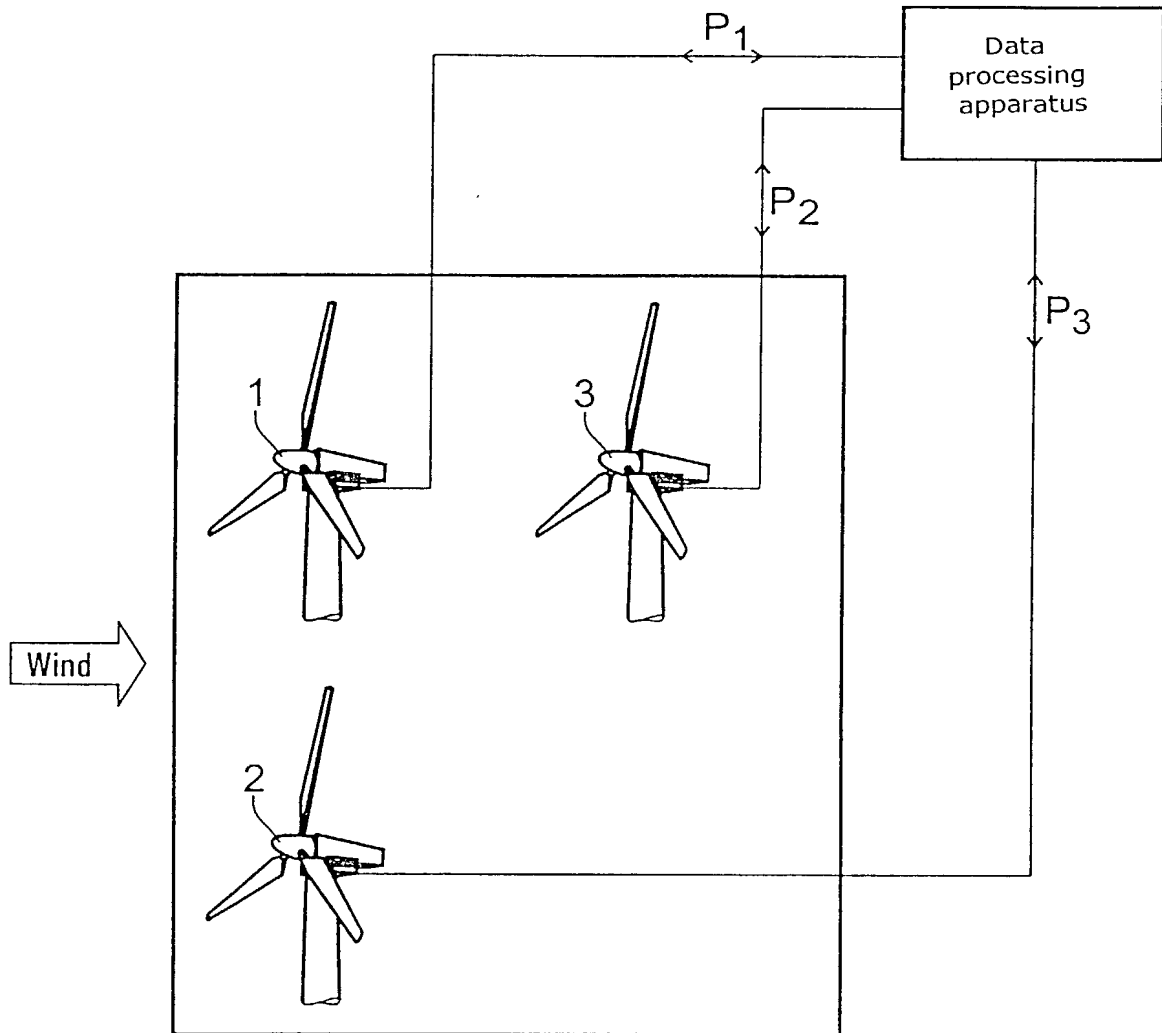


Fig. 2

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DECLARATION AND POWER OF ATTORNEY

As a below-named inventor, I hereby declare that:

My residence, mailing address, and citizenship are as stated below next to my name.

I believe that I am an original, first and joint inventor of the inventions described and claimed in the specification which was filed on April 2, 2002, assigned U.S. Application Serial No. 10/089,812, and entitled:

METHOD FOR OPERATING A WIND FARM

the specification of which was filed as PCT International Application No. PCT/EP00/06493 on July 8, 2000, and was amended on October 22, 2001.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 USC 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 35 USC 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below any foreign application for patent or inventor's certificate or of any PCT international application filed by me or my assignee disclosing the subject matter claimed in this application and having a filing date before that of the application on which priority is claimed:

PRIOR FOREIGN APPLICATION(S)

<u>Application No.</u>	<u>Country</u>	<u>Filing Date</u>	<u>Priority</u> <u>Not Claimed</u>
DE 199 48 196.2	Germany	6 October 1999	
PCT/EP00/06493	PCT	8 July 2000	

I hereby claim the benefit under 35 USC 120 of any United States application(s), or 35 USC 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in such prior applications in the manner provided by the first

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paragraph of 35 USC 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. PARENT APPLICATION OR PCT PARENT NUMBER

Application No.
PCT/EP00/06493

Filing Date
8 July 2000

Parent Patent Number

I hereby appoint Neil A. Steinberg, Reg. No. 34,735, who is a member of the Bar of the Commonwealth of Massachusetts and the District of Columbia, with full power of substitution and revocation to transact all business in the U.S. Patent and Trademark Office connected therewith. The current mailing address and telephone number of Neil A. Steinberg are:

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Steinberg & Whitt, LLP
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Suite 214
Mountain View, CA 94043

Telephone: 650-968-8079
Facsimile: 650-968-8102

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Citizenship: German
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W
Date: 16 May 2002

Wobben
Aloys Wobben